

REMARKS

Claims 1-34 are in the case. Claims 1-10, 12, 16, 18-20, 22-31, 33 and 34 are rejected, and claims 11, 13-15, 17, 21 and 32 are objected to. Claims 1, 11, 15, 21, 24, 32, and 34 are amended. Claim 30 is cancelled without prejudice.

By the present amendment, claims 1, 11, 15, 21, 24, 32, and 34 have been amended and claim 30 has been cancelled.

In the Office Letter dated 31 July, 2003, claim 30 was rejected under 35 U.S.C. § 112, second paragraph as being indefinite. The Examiner contends that there is insufficient antecedent basis for the limitation "said legs" in line 2.

Further, in said Office Letter, claims 1 - 10, 12, 16, 18 - 20, 22 - 31, and 33 were rejected under 35 U.S.C. § 103(a) over U.S. Patent No. 6,471,710 to Bucholtz. The Examiner contends that Bucholtz discloses a probe position sensing system comprising curvature sensors, a bend member 47 (Fig. 3), optical fibers 50 and detection device 54. The Examiner acknowledges the Bucholtz fails to teach the device as being used for a hydrophone array. The Examiner contends that it would have been obvious to modify Bucholtz's device to be utilized for the hydrophone array system because Bucholtz clearly teaches at column 13, lines 51 - end that the system can be utilized in a wide variety of medical and non-medical applications. With regard to claims 5, 6, 8, and 9, Bucholtz fails to show more

than one optical fiber Bragg grating embedded in each of the optical fibers. The Examiner contends that it would have been obvious to modify the Bucholtz device to include more than one optical fiber Bragg grating since it has been held that mere duplication of the essential working parts of a device involves only routine skill in the art. With regard to claim 10, the Examiner contends that element 41 functions as a coupling means.

Still further in said Office Letter, claim 34 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Bucholtz in view of U.S. Patent No. 6,127,672 to Danisch. The Examiner contends that Danisch teaches at column 11, lines 8 - 23, that combination of plurality of sensors. The Examiner contends that it would be obvious to modify Bucholtz's device to include the roll sensor for the purpose of accurate information of the property change in the device.

The foregoing rejections are traversed by the present response.

The present invention relates to a system for detecting curvature in a towed hydrophone array. The system comprises at least two curvature sensors positioned along the length of the towed hydrophone array; each of said curvature sensors comprising a bend member which bends as the array bends, at least one optical fiber within the bend member, and at least one detection device embedded within the at least one optical fiber

to detect a change in strain in the at least one optical fiber, and means for limiting the bending of the bend member and thereby the strain in the at least one optical fiber.

In another aspect, the present invention relates to a curvature sensor which comprises a bend member; at least one optical fiber within the bend member; at least one optical fiber to detect a change in strain in the at least one optical fiber; and means for limiting the bending of the bend member and thereby the strain in the at least one optical fiber.

In yet another aspect, the present invention relates to a system for determining the curvature and shape of a towed hydrophone array. The system comprises a plurality of curvature sensors positioned along the length of the towed hydrophone array; each of the curvature sensors comprising a bend member which bends as the array bends, at least one optical fiber within the bend member, at least one detection device embedded within the at least one optical fiber to detect a change in strain in said at least one optical fiber, and means for limiting the bending of the bend member and thereby the strain in the at least one optical fiber; and a plurality of roll sensors positioned along the length of the towed hydrophone array with each of the roll sensors being in close proximity to a respective one of the curvature sensors.

It is submitted that none of the cited and applied references teach or suggest the various claimed features of the present invention.

With regard to the rejection of claim 30 on indefiniteness grounds, this rejection has been mooted by the cancellation of claim 30.

With regard to the obviousness rejection of claims 1 -10, 12, 16, 18 - 20, 22 - 31, and 33 over Bucholtz, the rejection fails for a number of reasons. Most significantly, the rejection is pure hindsight. There is nothing which teaches or suggests the use of Bucholtz's system in a towed hydrophone array. A broad statement that something has uses in medical and non-medical applications is not a teaching of using a system in a towed hydrophone array. Assuming arguendo that one would modify Bucholtz's device to operate in a towed hydrophone array environment, Bucholtz still lacks all the claimed elements. In particular, Bucholtz lacks a bend limiter. The Examiner's position that element 47 in Fig. 3 clearly limits the bending of the optical fiber is not supported by the Bucholtz patent. Element 47 is referred to once, and is described as the interior of lumen 42. The fibers in the interior (50, 56) are described as being bonded to the wall 46 in order for the strain from bending the lumen 42 be transmitted to the fiber. This would suggest that there is no material in the interior 47 to limit

the strain. It appears that 47 is used only to designate a geographical position in the structure rather than a structural element. In column 4, line 3, the lumens are described as acting as passageways for sets of fiber optic cables. This further gives the impression that the interior of the lumen 47 is open space rather than another structure.

There is nothing in the Bucholtz patent to suggest that there is any intent to limit the bending anywhere in the flexible joint. The very term "flexible joint" suggests a wide range of bending flexibility. The purpose of a flexible joint is to flex. The purpose of the material inside the rotary joint is to transmit the bending strain to the lumens while controlling the position of the lumens relative to the neutral axis. The purpose of the lumen wall is to be strained as the flexible joint is bent. The cables are fixed to the lumen wall so that the bending strain is coupled to the fiber. Neither the lumen interior, or the lumen wall, or the flexible joint interior, or the flexible joint is described as or intended to limit the bending.

One of the key aspects of the present invention is the claimed limiting means. This feature is not included in Bucholtz. Bucholtz states in column 10, lines 21 to 34: "[h]ence, it is possible to design the flexible joint 38 such that, although the strain in the joint material is larger than a

few percent, the strain in the strand 56 is safely less than a few percent. This safety arrangement can be at the expense of the reduced angle accuracy at small bend angles. Conversely, the flexible joint materials may be chosen such that the strain efficiency is nearly unity but then care should be taken to restrict the bend angles to values small enough to prevent mechanical failure of the strands 56. In addition ... the strain experienced by the strands 56 depends on the location of the strands relative to the neutral bend axis 61 of the joint 38." Thus, Bucholtz points out the basic problem without solving it. The fiber strain must be held to less than a few percent in order to not break the fiber. Bucholtz's solution to the problem is to place the lumen closer to the central axis of the flexible joint so that it sees less strain.

Bucholtz does not describe a material for the wall of the lumen that would have a high modulus. In the present case, the bend limiter is a rigid material providing a hard bend limit not dependent upon the applied force.

For these reasons, claims 1 and 24, as well as their dependent claims, are allowable over Bucholtz.

With regard to claim 34, this claim is allowable for the same reasons as claim 1. The Danisch patent does not cure the aforenoted deficiencies of Bucholtz.

Claims 11, 21, and 32 have been placed into independent form. Thus, these claims and their dependent claims are allowable.

For the foregoing reasons, the instant application is believed to be in condition for allowance. Such allowance is respectfully solicited.

The Examiner is invited to phone Michael F. Oglo, Attorney for Applicant, 401-832-4736 if, in the opinion of the Examiner, such a telephone call would serve to expedite the prosecution of subject patent application.

Respectfully submitted,

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